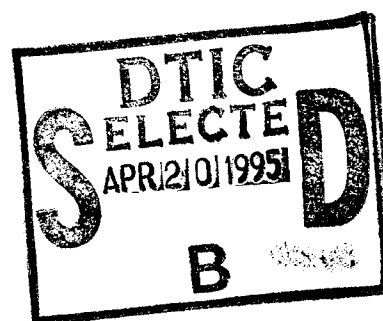
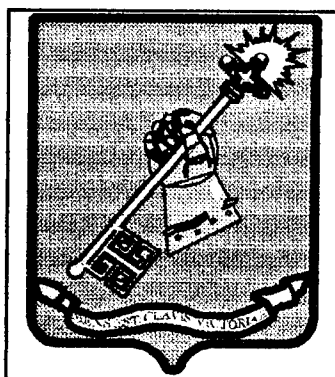


**EXPLOITING TECHNOLOGY:**

**SHOULD THE UNITED STATES ARMY EMPLOY THE  
RAH-66 COMANCHE TO PERFORM SEAD MISSION?**

**A Monograph  
by**

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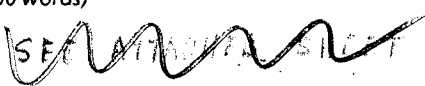
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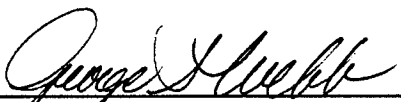
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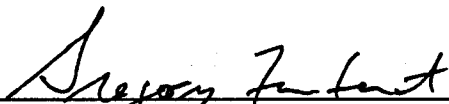
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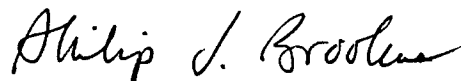
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## ABSTRACT

EXPLOITING TECHNOLOGY: SHOULD THE UNITED STATES ARMY EMPLOY THE RAH-66 COMANCHE TO PERFORM SEAD MISSIONS?

by MAJ Bruce J. Reider, USA, 54 pages.

This monograph discusses employment of the RAH-66 Comanche helicopter to determine whether the United States Army should use it as an asset to perform suppression of enemy air defense (SEAD) missions. The Army does not utilize its aircraft to deliberately seek out and attack enemy air defense systems. The Army relies on the United States Air Force to conduct deliberate SEAD operations.

The monograph begins with an introduction to describe the nature of the problem. The next section contains a description of the typical integrated air defense system (IADS) and its specific component weapon types in order to establish a framework for analysis. The purpose of the third section is to determine whether the Comanche is technologically capable of performing SEAD operations. The fourth section consists of a discussion of the tactical feasibility of suppressing enemy air defenses with the Comanche. The fifth section focuses on implications of using the Comanche as a SEAD platform in terms of battlefield responsibilities, doctrine, training and attitudes. The monograph concludes with the answer to the research problem.

The United States Army should employ the RAH-66 Comanche to suppress enemy air defenses. Aircraft will require continued protection from threat air defense systems. The Comanche is technologically and tactically capable of conducting SEAD missions. Air Force plans to restructure its suppression of enemy air defenses capability will force the Army to provide its own SEAD to support future operations. There is no reason not to use the Comanche as a SEAD platform.

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## I. INTRODUCTION

At H-hour minus twenty-two minutes (0238C) on 17 January 1991, Task Force Normandy, composed of United States Air Force (USAF) MH-53J Pave Low and United States Army (USA) AH-64 Apache helicopters, destroyed two Iraqi early warning and ground control intercept (EW/GCI) sites.<sup>1</sup> Their actions created a radar-free gap, 40 kilometers wide, for the initial coalition airstrike into Iraq that began Operation Desert Storm.<sup>2</sup>

The purpose of this monograph is to determine whether the U.S. Army should employ its newest helicopter, the RAH-66 Comanche, to perform similar suppression of enemy air defense (SEAD) missions. Despite the fact that the Army does not expect the first Comanche unit to be operational until 2003, now is the time for the Army to decide how it will employ the Comanche.

Joint Pub 3-01.4, JTTP for Joint Suppression of Enemy Air Defenses (J-SEAD), defines suppression of enemy air defenses as "any activity that neutralizes, destroys or temporarily degrades enemy surface-based air defenses by destructive and/or disruptive means."<sup>3</sup> J-SEAD is "a broad term that encompasses all SEAD activities provided by components of a joint force in support of one another."<sup>4</sup> Successful SEAD requires active offensive actions; SEAD is not a passive activity.

Joint Pub 3-01.4 describes three categories of J-SEAD: theater air defense suppression, localized suppression and opportune suppression. Detailed planning and coordination characterize theater air defense suppression and localized suppression. Opportune suppression is usually unplanned and typically limited to aircrew self-defense and attack against targets of opportunity.

Task Force Normandy established a precedent. Army aviation did not execute preplanned J-SEAD missions prior to Operation Desert Storm. Instead it operated in the realm of opportune suppression. Pilots learned to detect and avoid air defense systems. They engaged air defense systems only to provide the suppression necessary to break contact when chance encounters occurred. Technology was the main factor that limited the role of Army aviation in SEAD operations. Air defense systems were more capable of killing helicopters than helicopters were of killing air defense systems.

The development of the RAH-66 Comanche will shift the odds to the side of the helicopter. The Comanche's technology, coupled with improved missiles, will enable its pilots to detect, locate, identify and attack air defense systems beyond their ability to see them. The RAH-66 is intended primarily as a reconnaissance aircraft. SEAD will probably remain a secondary function unless a decision is made to exploit the Comanche's technology and expand the role of helicopters in SEAD.

This monograph focuses on four major areas: capabilities, limitations and employment characteristics of the major air defense systems throughout the world; RAH-66 Comanche capabilities and limitations; Comanche employment options as a SEAD platform; and the implications in terms of doctrine, training, roles and missions. The first area describes the integrated air defense model most likely to be found throughout the world. The second area focuses on Comanche's technological attributes to determine if it can successfully perform suppression of enemy air defense operations. The next area discusses the tactical feasibility of using the Comanche to suppress enemy air defenses. It examines USAF tactics, techniques and procedures which could be adapted to the Comanche in order to accomplish the SEAD mission. The final area identifies some of the other major factors bearing on the problem (lack of doctrine, training implications, competing roles and missions) that probably would influence the decision of whether or not to use the RAH-66 Comanche as a SEAD platform.

The monograph concludes with a review and summary of the major points. The conclusion answers the research question and poses new questions on the role of Army aviation in the future.

## II. THREAT ANALYSIS

The purpose of this section is to establish a common understanding of basic air defense doctrine to include organization and command and control. It also describes the capabilities and limitations of the different categories of air defense systems.

Air defense weapons may be employed autonomously; however, normally they are part of an integrated air defense system (IADS). IADS is an acronym that describes any integrated air defense architecture organized along national, allegiance or subnational lines.<sup>5</sup> JCS Pub 3-01.4 lists four features of integrated air defense systems. First, they provide detection, identification and warning of air threats. Second, their aim is destruction or neutralization of hostile aircraft before they threaten forces and critical assets. Third, they offer redundant protection for high value assets, strategic locations, key communications nodes and critical military units. Fourth, they attempt to jam aircraft navigation, communications and target acquisition systems to degrade their effectiveness.<sup>6</sup>

Rigid centralized control and decentralized execution are the most important characteristics of integrated air defense systems. They rely on centralized command and control nodes connected with redundant communications to provide early warning, assign targets and control weapons status.<sup>7</sup> This characteristic is both the major strength and

major weakness of integrated air defense systems.

A typical IADS (Figure II-1) contains a number of geographically designated sectors. A sector operations center (SOC) controls each sector. A national or regional air defense operations center (ADOC) controls the SOC's.<sup>8</sup>

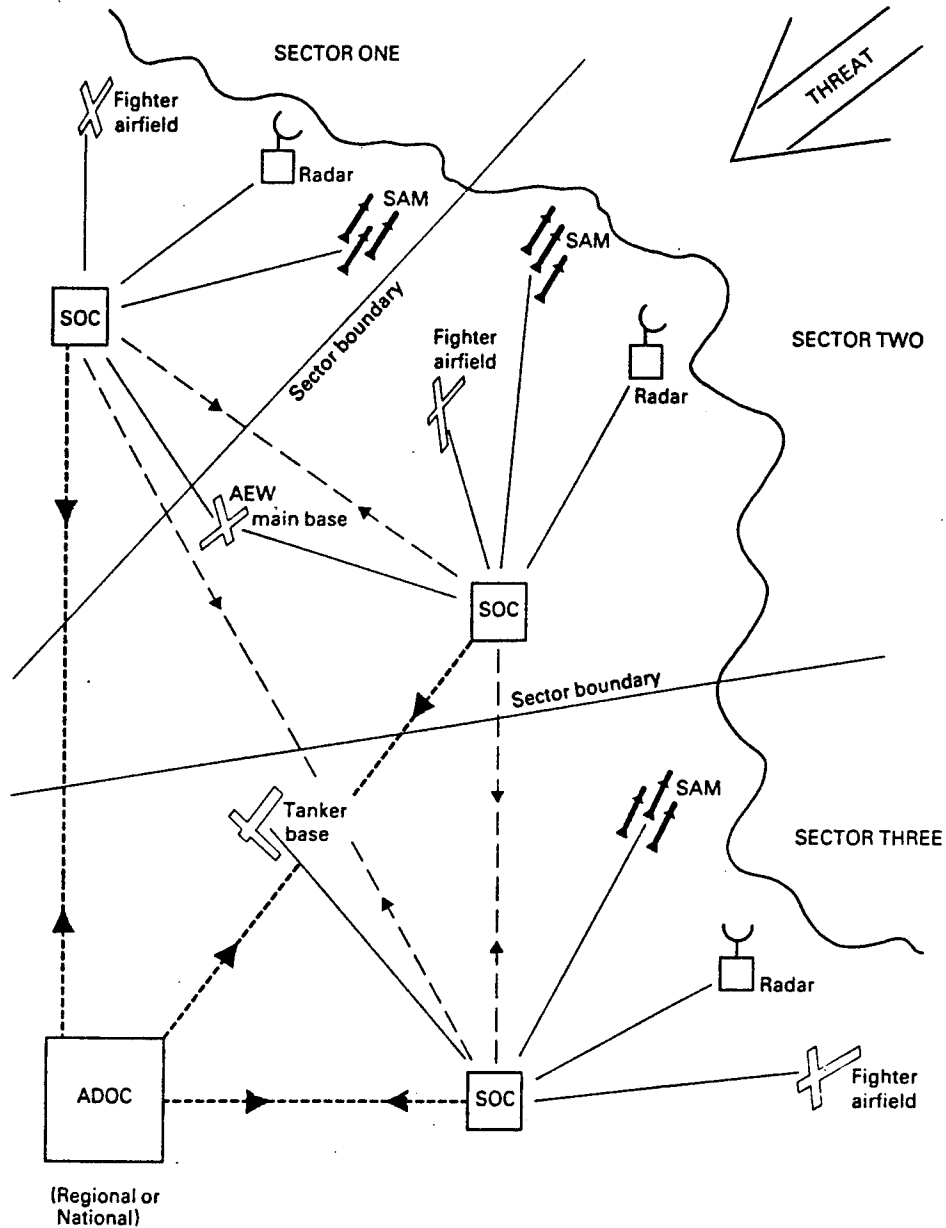


Figure II-1.<sup>9</sup>

The 1990 Iraqi system was an excellent example of an integrated air defense system. The Iraqi Air and Air Defense Force (IAADF) was responsible for Iraq's strategic air defense. The IAADF's air defense operations center assigned air defense priorities, but it did not exercise direct control over operations within the five air defense sectors. A SOC controlled each air defense sector and was responsible for all air defense within its assigned area. Within each SOC were several intercept operations centers (IOCs). The IOCs consisted of a network of visual and radar reporting stations.<sup>10</sup> The brain of the entire Iraqi IADS was a computerized command and control system known as KARI.<sup>11</sup>

A 1985 study determined, "the best air defense networks have always been defeated."<sup>12</sup> One of the initial objectives of Coalition theater air defense system suppression operations was "to bewilder the Iraqi air defense system."<sup>13</sup> The initial plan called for F-117s to attack key nodes of the Iraqi air defense system while Tomahawk Land-Attack Missiles (TLAMs) attacked the electrical power grid that powered the IADS. The purpose of the TLAM attack was to force the Iraqis to resort to backup electrical power to restore their air defense system. While the Iraqis shifted to backup power the Coalition would flood Iraqi airspace with aircraft. Planners hoped that the mass of targets would overload the Iraqi IADS once power was restored.<sup>14</sup> The Coalition's efforts were extremely effective; they reduced

the Iraqi air defenses to uncoordinated local efforts.<sup>15</sup>

"The Iraqi integrated air defense system crumbled." <sup>16</sup>

All integrated air defenses array their assets in similar fashion on the battlefield. According to both the Soviet model and United States Army air defense doctrine, planners use four employment principles to design air defenses. Those principles are mass, mix, mobility and integration.<sup>17</sup>

Mass concentrates firepower to defend assets according to their priority. Mix ensures the right combination of weapon systems are used to defeat the threat. Proper mix reduces the defender's vulnerability and complicates the problem for the attacker. Mix enables the defender to maximize the capabilities and to minimize the limitations of each weapon system. Mobility provides the necessary flexibility to shift resources as priorities change. The maneuverability of mobile systems also increases their survivability. Integration means that air defenses support both the maneuver concept of the operation and each other.<sup>18</sup>

The Soviet air defense model<sup>19</sup> employs combined arms in three stages to protect their force. The goal of the first stage is to destroy enemy aircraft while they are on the ground at their bases. This stage corresponds to the JCS Pub 1-02 definition of offensive counterair. The second stage attempts to intercept enemy aircraft in flight after they leave their bases but before they reach Soviet ground

forces. This stage is known as defensive counterair in U.S. military doctrine. The objective of the third stage of the Soviet model is to destroy enemy aircraft that penetrate the airspace over ground units. This stage is the focus of tactical air defense forces.<sup>20</sup> Stage three also defines the primary area of concern for SEAD operations.

Tactical air defenses deploy their assets to form a defense-in-depth. Echelonment integrates air defenses externally with similarly organized ground forces and internally among systems.<sup>21</sup> Each belt is mutually supporting and linked to the IADS for early warning and target cuing.

Another aspect of tactical air defenses is the concept of point and area defense.<sup>22</sup> Point defense protects specific assets. Area defense provides general protection for a certain geographic area. Air defense planners assign areas to ensure overlapping fires. Supplemental weapons cover dead space. The particular characteristics of a weapon usually define its role as a point or area defense system.

Tactical air defenses contain two types of weapon systems: medium range surface-to-air missiles (MSAM) and short range air defense systems (SHORAD). SHORAD systems consist of two subdivisions: short range missiles and antiaircraft guns.<sup>23</sup>

Medium range surface-to-air missiles provide area coverage. They are usually less mobile than SHORAD systems and generally unable to perform short range engagements.

Most MSAM rely on command guidance and semi-active homing to intercept their target. Command guidance systems have four components. A target tracker provides target trajectory information. A missile tracker sends missile trajectory information. A fire control computer compares missile and target trajectories and computes the ballistic equation for intercept. Finally, a command link relays control inputs to the missile according to the ballistic solution.<sup>24</sup>

SHORAD systems represent the principal threat to helicopter operations. Short range SAMs and antiaircraft (AA) guns make up the SHORAD category of air defense weapons. Short range SAMs may be vehicle-mounted or man-portable. SHORAD systems are usually linked to the IADS command and control network for early warning and target cuing. Additionally, many SHORAD systems possess their own radar systems.

There are two types of radars associated with air defense weapons: acquisition and tracking. The purpose of acquisition radars is to detect targets early enough to provide early warning for fire coordination. Tracking radars compute ballistic solutions to increase the probability of hitting the target.

Anti-aircraft guns are line-of-sight weapons designed to protect maneuver forces by covering the airspace below the SAM's minimum engagement altitude. Small arms and machinegun fire are other forms of AA that cannot be

overlooked.<sup>25</sup> "The vast majority of helicopters lost in combat have fallen to small arms fire."<sup>26</sup>

SHORAD systems have a variety of vulnerabilities. Often they don't receive sufficient early warning before they must react to an enemy attack. Their targets fly at much lower altitudes than MSAM targets. As a result their targets are often masked by ground clutter. Ground clutter refers to the presence of other material around the target which may hide or disguise it from electronic detection. Systems that rely strictly on optics to acquire and track their targets are vastly degraded during periods of limited visibility. Finally, radars emit their own peculiar signature that can lead to detection and targeting by enemy forces.

Air defense systems are readily available throughout the world. A recent study listed thirty-five surface-to-air missile systems and ten gun/missile complexes that can be obtained on the international market.<sup>27</sup> (Appendix A) For example, the world's first self-propelled gun/missile system, the 2S6M "Tunguska", is being actively marketed by the Commonwealth of Independent States (CIS).

The 2S6M is arguably the most capable air defense system in the world. It has an acquisition radar with an 18 kilometer range and a tracking radar with a 13 kilometer range. Its two 30mm twin-barrel automatic cannons have a 60% probability of kill (pk). The eight onboard ready-to-fire SAMs have a 65% pk.<sup>28</sup> The U.S. Army uses the "Tunguska" to

evaluate Comanche's capabilities.<sup>29</sup> (Appendix B)

The proliferation of advanced air defense weapon systems makes it likely that the United States military will face very capable adversaries in future conflicts. Pilots could confront sophisticated air defense networks like the Iraqi IADS. They could also encounter just a few independent systems. The Soviet Union discovered in Afghanistan that air defense weapons do not require a refined structure to operate effectively. There are more air defense weapons in the world than ever before. The United States must strive to find new ways to counter this growing threat.

A well-organized tactical air defense creates a formidable umbrella to protect maneuver forces and other critical assets. The key to penetrating that shield is to attack it on two fronts. First, the attacker should attempt to reduce an IADS into isolated elements by attacking its command and control structure. Secondly, the attacker should seek to defeat the tactical air defense structure by exploiting the weaknesses and limitations of each component weapon system.

An understanding of basic air defense command and control, organization and operation is an essential aspect of any decision to use the RAH-66 as a SEAD platform and the role it might play in SEAD operations. Armed with that information, the next step is to analyze the capabilities of the Comanche.

### III. COMANCHE CAPABILITIES

The RAH-66 Comanche is the United States Army's first helicopter designed for attack, armed reconnaissance and air combat missions. Comanche uses low-observable technology to avoid detection and long-range sensors to fire from maximum standoff distances. Low-observable technology involves the "systematic suppression of the detection signatures in various emission spectra, including, but not limited to radar."<sup>30</sup>

The purpose of this section is to determine the technological feasibility of using the RAH-66 Comanche as a SEAD platform. This section consists of two parts. The first part addresses the Comanche's ability to avoid detection by threat air defense systems. The second part discusses Comanche's ability to detect, locate, identify and attack those systems.

The survivability of a helicopter depends largely upon its ability to avoid detection. The simplest method to avoid detection is to reduce the aircraft signature. There are four distinct features of a helicopter's signature: visual, audible, thermal or infrared (IR) and radar.

The combination of infrared suppressive paint and a flat plate canopy decreases Comanche's likelihood of visual detection. As a result, it has a signature that is 1.8 times smaller than that of an AH-64 Apache and 1.2 times smaller than the visual signature of an OH-58D Kiowa Warrior.<sup>31</sup>

The acoustic signature of the Comanche is 1.6 times less than that of the Apache and 1.1 times less than that of the Kiowa Warrior.<sup>32</sup> The Comanche main rotor system features parabolic tip shapes designed to reduce aircraft noise production.<sup>33</sup>

An integrated infrared suppression system significantly reduces the Comanche's thermal signature. The RAH-66 is the first United States Army helicopter to incorporate IR suppression into the design of the aircraft. Prior to Comanche, IR suppression was an afterthought, "something to be bolted behind or beside engines."<sup>34</sup> The RAH-66 integrated IR suppression system "dilutes exhaust with environmental control system (ECS), avionics bay and ambient air drawn in through slots atop the tail boom."<sup>35</sup> The cooled air leaves through long thin slots on the bottom of the tail boom. The Comanche team claims the thermal signature of the RAH-66 is so low that the General Dynamics Stinger seeker is unable to obtain lock-on. The signature is so small that Comanche will be fielded without an IR jammer. However, it will include provisions for one to counter future IR threats.<sup>36</sup> Compared to the Apache and the Kiowa Warrior, the Comanche has a 2.75 and 1.15 times smaller IR signature respectively.<sup>37</sup>

The final component of a helicopter's signature is its radar signature. This component represents Comanche's most significant improvement over other helicopters.

Successful air defense depends mainly on early warning.

Early warning is a generic phrase that encompasses all the means to detect an attacker as soon as possible. Radar is the primary means for early warning in most air defense networks; it gives many individual air defense systems their acquisition and tracking features.<sup>38</sup>

Radar waves are limited to line-of-sight, although at least two radar systems can circumvent that limitation. One system, over-the-horizon radar (OTHR), detects targets 1000 to 4000 kilometers from the radar, but has no close-in capability. The other system, high frequency surface wave radar (HFSWR), only works over salt water at ranges up to 185 kilometers. Neither OTHR nor HFSWR significantly affects helicopter operations over land.<sup>39</sup> Line-of-sight is a limitation of radar waves that all helicopters can exploit through terrain flight techniques to enhance their survivability.

Radar waves have other characteristics; they can be deflected, reflected, diffused or absorbed. Radar systems transmit waves and detect targets when the waves are reflected back from objects. Many factors affect the reflectivity of a helicopter. Those factors include its surface texture, the angular constructions in the aircraft frame (known as 'corner reflectors'), reflections from engine turbine blades and rotor blades, the type of paint used, and reflections from protrusions such as weapons carriage rails, missile pylons and landing gears. However,

size and aspect, the physical dimensions of a target which are presented to the radar, are the biggest determinants of an object's radar reflectivity.<sup>40</sup>

Radar cross section (RCS) is the level of radar reflectivity of an object measured in square meters.<sup>41</sup> The detection range of all radars "varies with the fourth root of RCS measured in square units."<sup>42</sup> The key to reducing an aircraft's risk of radar detection is to minimize its radar cross section.

Engineers used composite materials to reduce Comanche's RCS. Internally, the main support structure is a 25 feet long graphite keel beam that runs the length of the forward fuselage. The beam carries structural loads and contains 260 gallons of fuel. The other primary load-bearing structures are also made of graphite. The remainder of the airframe is an epoxy mixture of graphite and kevlar. The secondary structures, such as doors and fairings, provide a radar-absorbent skin of kevlar honeycomb. Small amounts of copper foil add lightning protection to the nonmetallic parts. The main rotor blades have graphite spars and glass skins. Finally, the fantail rotor blades consist of a polyurethane and synthetic foam core surrounded by a glass skin.<sup>43</sup> The resultant airframe contains about 55% composite materials instead of the metal construction used in older helicopters. In addition to reducing RCS, composite materials enhance survivability by reducing the aircraft's weight and

improving its maneuverability.<sup>44</sup>

The Comanche's radar cross section is an incredible 663 times smaller than the radar cross section of the AH-64 Apache and 263 times smaller than that of the OH-58D Kiowa Warrior.<sup>45</sup> The radar signature is so small that the RAH-66 will not include a radar jamming system. However, it will include provisions for one if radar systems develop a counter-stealth or counter-low observable capability.<sup>46</sup>

Comanche's ability to detect, locate, identify and attack enemy air defense systems is as impressive as its ability to avoid detection. Through a variety of fully integrated, technologically enhanced systems the RAH-66 represents "a revolution in battlefield communications."<sup>47</sup>

An electro-optic sensor system (EOSS) contains two improved forward-looking infrared (FLIR) sensors, a solid-state television and a laser designator/rangefinder. The second generation FLIR increases the pilot's viewing area by 50%, increases range by 40% and improves quality by 100%.<sup>48</sup> A low-light-level television augments the FLIR to improve its effectiveness during environmental conditions not conducive to FLIR operations. The EOSS enhances safety and detects targets faster and at greater ranges.

Another feature that enhances survivability is a cockpit digital electronic map display. The map display gives the crew a near-three-dimensional view of the aircraft's flight route. It incorporates inputs from other

sensors and depicts threat radar detection envelopes as the aircraft altitude changes. This feature enables the pilot to adjust his altitude and airspeed according to the threat.

The electro-optical target acquisition/designation system (EOTADS) greatly decreases aircraft exposure time. The sensor system can scan a designated area while the aircraft is stationary or maneuvering, record everything it sees and store it in computer memory.<sup>49</sup> According to Russ Stiles, Comanche Chief Test Pilot, "the system moves so fast that you can't see anything [on the displays] while the scan is happening."<sup>50</sup>

The EOTADS feeds information into the aided target detection/classification (ATD/C) system. The ATD/C prioritizes targets according to their threat potential. "The aided target detection/classification system will reduce the time required to locate and classify threats and targets by 90% from current aircraft, giving the RAH-66 a 'see first/shoot first' capability."<sup>51</sup>

Comanche can rapidly transfer automated target data to other weapon systems. It can relay precise target locations using digital data burst communications. Instead of manually entering data on a computer keyboard in the cockpit, the crew can pass information directly from onboard systems with the push of a button.<sup>52</sup>

The RAH-66 engages targets with a variety of weapons. It can fire Hellfire missiles, air-to-air Stinger missiles,

Hydra-70 rockets, or a variety of 20mm rounds, the latter from its nose-mounted Vulcan II gatling gun. An integrated flight and fire control system (IFFC) stabilizes the aircraft during rocket or gun engagements. IFFC can reduce a 250 x 1000 meter rocket impact area to a 66 x 18 meter box.<sup>53</sup>

The Comanche will have the ability to fire the Longbow Hellfire Modular Missile System (LBHMMS). The LBHMMS is a fire-and-forget missile system that incorporates an active radio frequency (RF) seeker. LBHMMS is a component of the Longbow Weapon System. The Longbow Weapon System also includes a radio frequency interferometer (RFI) and a fire control radar (FCR). "The RFI automatically performs detection, identification, and direction finding of radar emitting targets for servicing or avoidance."<sup>54</sup> "The FCR is a millimeter wave (MMW), coherent doppler radar with a sensor mounted above the main rotor system."<sup>55</sup> It will classify target returns as air defense systems, tracked or wheeled vehicles, and rotary or fixed-wing aircraft.<sup>56</sup>

The United States Army is developing an improved missile known as The Army Combined Arms Weapon System (TACAWS). The TACAWS program goal is to produce a missile with the following features:

1. Destroys helicopters and armored vehicles in clutter at extended ranges (6 kilometers required, 10 kilometers desired).
2. Multi-role: air-to-ground (ATG), air-to-air (ATA), ground-to-air (GTA) and ground-to-ground (GTG).
3. Multi-platform (to include the RAH-66 Comanche).

4. TOW launcher compatible.
5. Fire-and-forget as the primary mode of operation.<sup>57</sup>

The fire-and-forget feature is a critical aspect of TACAWS. Fire-and forget increases platform survivability by reducing crew workload and aircraft exposure time.

The most desirable method for destroying threat radars is to use fire-and-forget anti-radiation missiles, such as the AGM-88 HARM, which home in on the signal emitted by the radar itself. There are no plans to adapt the AGM-88 HARM for use by the Comanche. However, both TACAWS and the LBHMMS will enable the Comanche to destroy targets from maximum standoff without relying on terminal guidance for missile function.

Comanche is technologically capable of defeating any air defense weapon. Its ability to detect, locate, identify and attack targets is superior to that of any rotary-wing aircraft in the world. It has the smallest signature of any helicopter in existence. However, survivability is not only a function of technology but also of tactics and training.<sup>58</sup>

There is no such thing as an invisible airplane. Signatures can be suppressed; they cannot be eliminated. Technology cannot be divorced from tactics. Stupid tactics can negate overwhelming technological advantages, while intelligent tactics applied in a timely and decisive manner can overcome crippling technological deficiencies.<sup>59</sup>

The next section explores the issue of RAH-66 Comanche tactical employment.

#### IV. EMPLOYMENT OPTIONS

The RAH-66 will give Army aviation the technological advantage to successfully perform SEAD missions until upgraded air defense systems tilt the scales in the other direction. Experts do not expect that shift to occur until air defense systems are developed which can defeat stealth technology. Counter-low observables technology is still in the research stage<sup>60</sup> and, once developed, its availability is unlikely to become widespread. That leaves tactics as the next area to consider in the decision of whether to use the Comanche as a SEAD platform.

The purpose of this section is to determine the tactical feasibility of using the Comanche to conduct deliberate, preplanned destructive suppression missions. The first step toward an answer is to examine existing suppression of enemy air defenses doctrine. Joint Pub 3-01.4, JTTP for Joint Suppression of Enemy Air Defenses, is the overarching doctrinal manual for the conduct of J-SEAD. It provides the framework for suppression employment options. According to Joint Pub 3-01.4 there are three categories of J-SEAD operations and two means to accomplish J-SEAD.

The two means to suppress enemy air defense systems are destructive and disruptive. The goal of destructive suppression is to destroy enemy air defense systems. The goal of disruptive suppression is to temporarily deny,

degrade, deceive, delay or neutralize enemy air defense systems. Disruptive SEAD may be active or passive. Passive disruption utilizes a combination of aircraft design technology and onboard warning receivers to reduce the capabilities of air defense systems by avoiding detection. Stealth technology is an example of passive disruption. Active disruption uses a variety of nonlethal methods to attack air defenses to temporarily disrupt their capabilities. Electronic attack (electromagnetic jamming) and the use of expendables (chaff and flares) are examples of active disruption.<sup>61</sup>

Active disruption of threat air defense systems defeats the purpose of low-observable technology by producing an aircraft signature which will increase the probability of detection. Passive disruption of threat air defense systems is an inherent characteristic of Comanche's low-observable technology and does not rely on any special tactics for success. Nonetheless, the RAH-66 is better suited to conduct destructive suppression of enemy air defense systems. The best way to utilize the Comanche during SEAD missions is as a means to destroy threat air defense systems. Destructive suppression effectively exploits all of Comanche's technology.

Theater air defense suppression is the first category of J-SEAD defined in Joint Pub 3-01.4. It encompasses all theater or area of responsibility (AOR) actions to create

increasingly favorable conditions for friendly air operations. In contrast, the second category, localized J-SEAD, normally supports specific missions for a specific period of time in a specified space. The first two categories are deliberate actions that rely on detailed planning and coordination for their success.<sup>62</sup> The third category, opportune suppression, is essentially an unplanned operation although it may incorporate preplanned immediate action drills. The focus of this study is on the use of the RAH-66 to perform theater air defense suppression and localized SEAD operations.

There is a lack of information in Army aviation doctrine to describe the tactical employment considerations for helicopters in preplanned SEAD missions. That fact is not surprising since Task Force Normandy marked the first time Army helicopters participated in preplanned J-SEAD operations. Historically, Army helicopters tended to avoid contact with air defense systems rather than seek them out. One independent study even suggested that "doctrinally, attack helicopters may easier survive on the battlefield through avoidance [of air defense weapons] rather than through offense."<sup>63</sup>

Army aviation doctrinal manuals recognize the necessity of SEAD. Some manuals even acknowledge the responsibility of Army aviation in SEAD operations. However, no doctrinal manual describes tactics, techniques or procedures (TTPs)

for conducting SEAD.

Army aviation's capstone manual, FM 1-100, Doctrinal Principles for Army Aviation in Combat Operations, typifies the lack of depth of SEAD information found in Army aviation doctrine.

Aviation cannot survive on the battlefield unless threat air defense target acquisition systems and weapons are located, suppressed, obscured or destroyed. Commanders must ensure that suppression of the enemy's air defenses is planned and coordinated in support of each combined arms operation.<sup>64</sup>

FM 1-100 even lists suppression of enemy air defenses as a capability of its attack mission.<sup>65</sup>

Another Army aviation doctrinal manual, FM 1-113, Assault Helicopter Battalion, emphasizes the need for SEAD during air assault operations. Lift units expect attack helicopters to provide enroute air assault security by suppressing enemy air defenses.

Unfortunately, FM 1-112, the tactics, techniques and procedures manual for attack helicopter operations, does not address conducting deliberate SEAD missions. FM 1-112 implies that attack helicopters suppress air defense systems as they encounter them on the battlefield.

United States Air Force doctrinal manuals are another source for suppression TTPs. The Air Force refined the concept of suppression of enemy air defenses during the Vietnam War. In response to an increasing surface-to-air missile threat, the USAF began flying SAM suppression missions which they code-named "Wild Weasel."<sup>66</sup>

The Air Force installed radar homing and warning (RHAW) equipment on selected aircraft to counter the SA-2 SAM threat. The RHAW equipment enabled those aircraft to detect, locate and attack North Vietnamese air defense radars. "Wild Weasel" aircraft preceded the main force to suppress SAMs. The main force could then safely fly above the range of anti-aircraft guns. Early SAM suppression missions were extremely hazardous. The only method available to destroy SAM sites was direct attack with bombs or rockets. Finally, in 1966, Air Force SEAD operations drastically improved. During April and May of 1966, the USAF launched its first AGM-45A Shrike antiradiation missiles (ARMs). The Shrike passively homes in on the SAM radar signal. ARMs reduced the risk to "Wild Weasel" missions by allowing aircrews to conduct standoff attacks on surface-to-air missile sites.<sup>67</sup>

Today, the F-4G is the only United States Air Force aircraft capable of detection, identification, location and destruction of threat emitters.<sup>68</sup> The F-4G is appropriately nicknamed the "Wild Weasel" because of its ability to "ferret out" and disrupt or destroy air defense systems.<sup>69</sup> F-4Gs flew 2,683 sorties during Operation Desert Storm.<sup>70</sup>

MCM 3-1, Volume 10, Tactical Employment Wild Weasel "First In, Last Out", is the United States Air Force doctrinal manual for the employment of the F-4G. MCM 3-1 contains very few F-4G tactics that are adaptable to the Comanche. It does describe procedures that can serve as the

basis for a Comanche doctrinal manual on SEAD operations.

The Air Force view of tactics is noteworthy. Their approach differs slightly from the way the Army looks at tactics. According to the Air Force, "tactics are presented for aircrew consideration in planning and will not be used for standardization; standardization suppresses tactical creativity and fosters predictability in combat."<sup>71</sup>

One MCM 3-1, Volume 10, lesson is to determine the nature of the SEAD mission. The J-SEAD category will determine whether the mission is autonomous or in support of another operation.

Theater air defense suppression missions are typically independent operations to suppress high payoff air defense assets such as radars and associated command, control and communications for early warning, GCI and long range SAM systems.<sup>72</sup> The advantage of autonomous SEAD missions is the tactical flexibility they offer to the aircrews performing the mission. Theater air defense suppression missions generally have a higher priority than localized suppression operations for SEAD assets.<sup>73</sup> When properly integrated into the campaign plan, the RAH-66 Comanche can participate in and enhance theater air defense suppression operations.

Localized suppression operations protect specific missions. Localized suppression operations typically support cross-FLOT combat search and rescue, air assault, attack or special operations missions.<sup>74</sup> Although the SEAD plan should

be an integral part of the overall mission, it is subject to the limitations of any supporting plan. Localized suppression is the least flexible category of J-SEAD.

There are two methods for conducting localized suppression. One technique is to precede the main force to suppress threat systems. This technique works best when the enemy situation is clear and the locations of enemy air defense assets are known. The other technique is to escort the main force along its route and suppress threats along the way. This is the appropriate technique to use when the enemy situation is unclear.

The Comanche can perform either method of localized suppression. However, due to the incompatible flight profiles between rotary and fixed-wing aircraft, the RAH-66 should not escort fixed-wing formations.

The concept of aerial escort is viable. A 1989 German study predicted that multirole escort helicopters would become the helicopter weapon system of the future. The study outlined German plans to develop an "escort" helicopter that could perform reconnaissance, attack, offensive counterair (OCA) and defensive counterair (DCA), as well as suppression of enemy air defense missions.<sup>75</sup>

Premission planning is another area where Comanche aircrews could adapt "Wild Weasel" procedures to help them prepare for SEAD missions. A critical aspect of any Air Force air defense suppression mission is to study and

analyze the threat electronic order of battle (EOB) for a particular area and even for a particular mission. Understanding the EOB is essential to determine penetration points, ingress and egress factors such as altitude, formation and routes, and the attack plan.<sup>76</sup> Premission planning procedures are applicable to any SEAD operation regardless of whether the asset that conducts the mission is an RAH-66 or an F-4G.

Joint Pub 3-01.4 is another source of premission planning considerations. It lists three planning objectives for J-SEAD operations. The first planning objective is to make an accurate appraisal of enemy air defenses and their ability to influence air operations. The second objective is to ascertain the level of SEAD operations necessary to suppress enemy air defense capabilities. The final planning objective is to determine the capabilities of available suppression assets.<sup>77</sup>

MCM 3-1, Volume 10, discusses night operations to decrease visual detection. Despite its superior technology, the Comanche is still vulnerable to visual detection and inadvertent overflight of air defense systems that visually acquire and track their targets. In a 1984 Military Review article, Major Charles L. Barry stated that small arms are the most critical visual threat to helicopters. The article went on to say that "operating at night eliminates the vast majority of small-arms fires."<sup>78</sup> The Falklands War is an

excellent example of the danger of daylight helicopter operations. "Helicopters from both sides, operating almost totally in the daylight, fell prey to small arms fire."<sup>79</sup> Comanche SEAD tactics should emphasize night operations to minimize visual detection possibilities and maximize Comanche's superior night fighting capabilities.

Three underlying themes seem to characterize successful suppression of enemy air defense tactics. First, they need to be innovative. Predictability leads to defeat when attacking air defense systems. Second, SEAD must be an integral part of the overall scheme of maneuver. Successful SEAD missions require prior planning and coordination. Finally, the combined effects of a variety of weapon systems produce the most successful results.

Israeli air operations during Operation Peace for Galilee are an excellent example of successfully suppressing enemy air defenses. Beginning on June 9, 1982, and lasting until September 1982, Israeli forces destroyed 29 Syrian surface-to-air missile sites. The initial raid destroyed 17 of the 19 SA-6 SAM positions located in the Bekka Valley of Lebanon. This first strike took only 10 minutes. A Rand Corporation study described the initial Israeli operation as a "highly orchestrated strike"<sup>80</sup> that was carefully planned and coordinated. The Israelis used innovative tactics such as launching remotely piloted vehicles (RPVs) as decoys to activate the SAM radars. After the Syrians launched their

missiles at the drones, Israeli aircraft attacked the sites. A Soviet Air Force report credited the RPVs (bespilotnyi samolet razvedchik) with "exhausting the opponents' air defense teams."<sup>81</sup> The Israelis also used tanks and artillery fires to attack missile sites in support their SEAD efforts.<sup>82</sup>

There are no tactical reasons why the United States Army could not use the RAH-66 as a SEAD platform. The Comanche is capable of performing either theater air defense suppression or localized suppression operations using destructive means. The lack of SEAD tactics, techniques and procedures in Army aviation doctrine can be overcome by modifying Air Force F-4G "Wild Weasel" suppression procedures to match Comanche's capabilities. Perhaps General Glen Otis, former Commander-in-Chief, U.S. Army Europe, best summarized the issue of helicopter employment doctrine. "The tactics and techniques in use [with helicopters] today are in their infancy compared to what they could do. Emphasizing technological developments, . . . will give us an advantage on the battlefield not available today."<sup>83</sup>

Thus far, neither technology nor tactics will preclude the use of the RAH-66 as a SEAD platform. The next area contains an examination of other factors that must be considered prior to deciding to conduct suppression of enemy air defense operations with the Comanche.

## V. IMPLICATIONS

The decision whether to use the RAH-66 Comanche as a SEAD platform is complex. It involves more than a simple technological or tactical analysis. There are other factors to consider. This area explores four of those other factors to determine their impact on the issue. The first topic is how Comanche SEAD operations might affect Service responsibilities to perform SEAD. The second factor is the impact on doctrine. The effect on training is the third factor. The final factor involves overcoming the Army's attitude toward SEAD operations.

The U.S. Department of Defense tasks all the services to perform suppression of enemy air defenses.<sup>84</sup> During Operation Desert Storm, the Army, Navy, Air Force and Marine Corps all conducted SEAD missions. The Air Force fired 1,067 HARMs from F-4G and F-16 aircraft. The Navy and Marine Corps used EA-6, A-6, and F/A-18 aircraft to fire 894 HARMs.<sup>85</sup>

On June 15, 1984, the Chiefs of Staff of the Army and the Air Force signed a Joint Service Agreement (JSA) to delineate responsibilities for joint suppression of enemy air defenses. According to the J-SEAD agreement, the Army is the primary agency responsible for SEAD execution out to the limits of observed fire. In that area, the Air Force has secondary responsibility to conduct suppression. The USAF is the primary agency responsible for SEAD execution from the limits of observed fire out to the limits of unobserved

indirect fires. The Army has the secondary responsibility for suppression in that area. The Air Force is the sole agency responsible for SEAD execution beyond the limits of unobserved indirect fires.<sup>86</sup>

At that time, the Army viewed SEAD as a mission to support Air Force operations. The opinion prevalent throughout Army aviation during the early 1980s was that "deep attacks were too risky and, given the needs and advantages of the defensive battle, that helicopters would be better used in positions behind the friendly side of the front."<sup>87</sup>

That attitude has changed, and cross-FLOT operations by helicopters are now an integral part of Army doctrine. However, the Army's view of SEAD operations remains relatively unchanged since the original J-SEAD agreement. As a result, there now exists a void on the battlefield. The Air Force cannot provide enough localized suppression to protect every helicopter operation across the FLOT. Comanche can fill that void by providing Army commanders with their own localized suppression asset.

In 1993, the U.S. General Accounting Office (GAO) published a report on Air Force SEAD plans for the future. According to the report, the USAF plans to eliminate dedicated SEAD units and retire the F-4G "Wild Weasel" by the year 2000. They intend to equip some F-15 and F-16 aircraft with SEAD systems and assign select units the SEAD

mission as an additional task. The Air Force does not plan to field enough SEAD-equipped aircraft to replace all the F-4Gs. The result will mean fewer and potentially less capable assets to conduct suppression of enemy air defense missions. The report concluded that U.S. combat aircraft would face greater risk in future conflicts if the Air Force proceeds according to their plans.<sup>88</sup>

Fewer Air Force SEAD assets and greater Army SEAD requirements will force the Army to increase localized suppression operations beyond the limits of unobserved indirect fires to support helicopter cross-FLOT operations. This will inevitably lead to a reassessment of Service roles and missions in the area of SEAD operations. Comanche participation in suppression of enemy air defense missions will necessitate a review of the division of battlefield responsibilities for SEAD. Furthermore, integrating the Comanche into campaign SEAD plans could expand the already heated debate over control of the battlefield area forward of the FLOT.

The second factor to consider is the impact on doctrine. The concept of using Army helicopters to seek out and destroy air defense systems will require a revision of many doctrinal manuals. Doctrine writers will be confronted with having to develop doctrine from scratch.

Section IV suggested using the F-4G, Wild Weasel, tactical procedures contained in MCM 3-1, Volume 10, as a

basis for developing Comanche SEAD doctrine. Another idea is to conduct a field trial to test the validity of doctrinal proposals or to discover new techniques for helicopter SEAD.

The Joint Attack Helicopter Instrumented Evaluation, also known as the Ansbach trial, is an example of the utility of such a test. The United States, Canada and West Germany conducted the Ansbach trial in June 1972. The Ansbach trial evaluated the capabilities of two different combinations of scout and attack helicopters in three defensive scenarios against an opposing force consisting of tanks and air defense weapon systems. The trial substantiated the belief that attack helicopters could successfully employ long range antitank guided missiles (ATGMs) against enemy armor formations.

The Ansbach trial also led to the development of new techniques for attack helicopter operations. The "pop-up maneuver" was one technique that arose from the Ansbach trial. It was designed to minimize exposure time to threat air defense weapons. The pop-up maneuver "involved an attack helicopter hiding behind vegetation or buildings, rising up to acquire a target, firing its weapons and then resuming cover."<sup>89</sup> This technique enabled attack helicopters to fire at their targets before enemy air defense weapons could acquire, track and engage them. The pop-up maneuver became a fundamental feature of attack helicopter operations. Today, Army aviation doctrine refers to this technique as "masking

and unmasking."<sup>90</sup>

Field trials are valuable tools for testing and evaluating doctrinal procedures and developing new tactics and techniques, but they are costly in terms of resources. Battle labs and simulations can help reduce the cost of doctrinal development. They can supplement field trials as a means for assessing doctrine before it is tested. However, tactics, techniques and procedures must be tested before they can be codified into doctrine, and field trials are one way to evaluate TTPs.

The decision to use the RAH-66 as a SEAD platform will have its greatest impact on doctrine in terms of resources. The commitment of people, time and money necessary to produce sound and useful doctrine is an important consideration in a decision on how to employ the Comanche.

The third factor for discussion is the impact on training. A program that trains Comanche pilots, crews and units to perform suppression missions according to the TTPs contained in doctrinal manuals will have to be developed. The program will also require Aircrew Training Manuals (ATMs) and unit Mission Training Plans (MTPs) containing tasks, conditions and standards. Those documents will have to be written. Qualified instructors are another aspect of a SEAD training program that will have to be resourced. The bottom line is that training requires the same categories of resources that doctrine required: people, time and money.

The final factor to consider is the attitude shift necessary to successfully employ the Comanche as a SEAD platform. There are two aspects to this factor. The first concerns the attitude of the ground maneuver commander, and the second is the mindset within Army aviation.

Ground commanders are understandably reluctant to give up assets for operations that do not directly support their mission. The use of artillery fires to suppress enemy air defense systems is a perfect example. Aviation brigades do not have a direct support(DS) artillery battalion habitually assigned to support them. Because "enemy ADA rarely constitutes his center of gravity,"<sup>91</sup> aviation units rarely receive adequate artillery support for SEAD operations. Commanders will face the same dilemma when deciding whether to use the Comanche to support J-SEAD operations or other missions more directly related to ground operations.

Aviators can also be expected to express reluctance over the idea of deliberately looking for and attacking their major threat. The tendency to avoid contact with air defense weapon systems is prevalent throughout Army aviation. The decision to employ the Comanche as a SEAD asset is likely to face strong resistance from veteran pilots and aviation commanders. Just like early efforts to conduct helicopter cross-FLOT operations, it will take time and strong assurances of success to convince the aviation community that Comanche SEAD operations are viable.

## CONCLUSION

The United States Army should decide to employ the RAH-66 Comanche as a platform to suppress enemy air defenses. This recommendation is based on several conclusions. First, aircraft will require continued protection from threat air defense weapon systems. Second, the Comanche is technologically and tactically capable of suppressing air defense weapon systems without undue risk to the crew or the aircraft. Third, the retirement of the F-4G will leave the Air Force with a marginal capability to support theater air defense suppression and provide localized suppression for their own missions. The Air Force will no longer be able to fulfill its J-SEAD agreement obligations to provide SEAD for Army aviation operations. As a result, the Army will be forced to provide its own SEAD. Finally, none of the other factors that could affect the decision to conduct Comanche SEAD operations are so overwhelming that they can't be overcome without cooperation and commitment.

The need for dedicated suppression will continue, and competition for SEAD assets will become greater as the Air Force retires the F-4G "Wild Weasel." In 1993, the Defense Intelligence Agency (DIA) completed a study that assessed threats to aircraft in the 2000 to 2005 timeframe. They identified a continued need for SEAD. The DIA study concluded that U.S. tactical aircraft "would face enemy air defense threats equal to or surpassing the current threat

and will require suppression to minimize losses."<sup>92</sup>

The GAO agreed with the DIA analysis and recommended that the "Secretary of Defense reevaluate funding priorities in light of the increased risk associated with SEAD capabilities."<sup>93</sup> If RAH-66 fielding continues according to Army plans, the Comanche will be able to fill partially the void in U.S. military SEAD capability that retiring the F-4G by the year 2000 would create.

Section II, Threat Analysis, described the nature of the air defense threat. In the future, U.S. forces are likely to face an integrated air defense system like the 1990 Iraqi model. Any IADS that U.S. forces encounter will probably be organized in a similar manner since both Western and Soviet doctrinal models for the development of an integrated air defense structure follow the same guidelines and principles. A typical IADS relies on a rigid centralized command and control structure to provide early warning, assign targets and control weapons status. This characteristic is a weakness that makes integrated air defense systems vulnerable to defeat. After breaking down the IADS structure, the next step is to systematically destroy the specific weapon systems that remain.<sup>94</sup>

The widespread proliferation of all types of weapons means that U.S. forces could encounter high quality weapons in the hands of any potential enemy during all levels of conflict. For example, the 2S6M "Tunguska" has reportedly

been sold to its first customer, an undisclosed Asian country.<sup>95</sup> According to the DIA, "the United States will continue to face systems and technologies developed by the former Soviet Union, Western Europe, and even the United States that are sold to potential regional adversaries."<sup>96</sup>

The Comanche is technologically capable of defeating the most sophisticated air defense weapons in existence. It can also contribute significantly to theater air defense suppression or localized suppression operations.

Major General John D. Robinson, the former Commander of the United States Army Aviation Center and Fort Rucker, stated that "through leap-ahead technologies, the Comanche will provide aviation warriors with the most impressive array of high-tech equipment ever assembled on a combat aircraft."<sup>97</sup> Section III described the "leap-ahead technologies" to which MG Robinson was referring.

One of these "leap-ahead technologies" is the use of low-observables to avoid detection. Comanche has the smallest signature of any helicopter in the world. Its visual, audible, infrared and radar signatures are so small that it can detect any emitting air defense weapon system before that system can detect it. This capability will reduce Comanche's vulnerability and increase its survivability. As a result, the Comanche can attack and destroy air defense systems with minimal risk.

The Comanche's ability to detect, locate, identify and

destroy threat ADA weapons is as impressive as its ability to avoid detection. The Comanche weapons system is a fully integrated system consisting of an electro-optical target acquisition/designation system and an aided target detection/classification system. The use of these systems in conjunction with Longbow Hellfire Modular Missile System will give Comanche a "fire-and-forget" capability.

Currently there are no tactical procedures for the Comanche to perform suppression of enemy air defense missions. However, section IV pointed out that Air Force F-4G "Wild Weasels" could be used as a basis for the development of Comanche SEAD tactics, techniques and procedures.

There are some other hurdles to overcome. The impact on roles and missions may lead to a reassignment of responsibilities for SEAD among the Services. The decision to employ the Comanche as a SEAD platform will also entail a major commitment in terms of resources to properly develop the doctrine and training programs required to adequately implement the decision. Finally, Comanche SEAD operations will require a fundamental change of attitudes by ground forces and members of the Army aviation community toward asset employment. These hurdles are not insurmountable, but they will necessitate a concerted effort by military and civilian leaders for resolution.

Aircraft are too valuable for the military not to

protect them from the threat of air defense weapon systems. The actions of one attack battalion, equipped with AH-64 Apache helicopters, during Operation Desert Storm exemplifies the tremendous capability that aviation assets bring to the battlefield. That battalion destroyed more than 170 tanks and armored vehicles in one deep attack mission.<sup>98</sup>

The authors of an article published in a 1994 issue of U.S. Army Aviation Digest contended that "SEAD, or maybe the way we view SEAD is 'broken.'"<sup>99</sup> If that is the case, then now is an opportune time to "fix" it, and Comanche is the right tool. "Comanche's technical capacity will present planners with more operational choices" than ever before.<sup>100</sup> One choice is clear: the United States Army should decide to exploit technology and use the RAH-66 Comanche to perform SEAD missions.

## Proliferation of Advanced Weapon Systems

### Long-Range Surveillance Radars



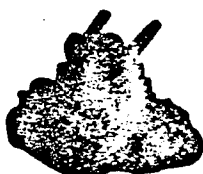
Elettronica 3-D Phased Array UHF (Italy)  
 Thomson-CSF RYAS UHF (France)  
 Lockheed-Sanders AN / TPS-44 Staring Array (US)  
 Tall King (CIS) AR-325 Commander (UK)  
 Tall Rack (CIS) PSM 33 (India)  
 Lanza (Spain) RAT-31SL (Italy)  
 TPS-70 / TPS-75 (US) Madras Program (Germany)  
 ARSR-1 (US) TRS 2215 / 2230 (France)

### Surface-to-Air Missiles



SA-5 (CIS)	SA-15 (CIS)	Starstreak (UK)	MSA 3.1 (Brazil)
SA-6 (CIS)	SA-X-17 (CIS)	Blowpipe (UK)	Akash (India)
SA-7 (CIS)	Patriot (US)	Rapier (UK)	Trishul (India)
SA-8 (CIS)	Hawk (US)	Aster (France)	RBS-70 (Sweden)
SA-9 (CIS)	Redeye (US)	Roland (France)	TLVS (Germany)
SA-10 (CIS)	Stinger (US)	Sky Bow 1 (Taiwan)	Crotale (France)
SA-11 (CIS)	HQ-61 (China)	Sky Bow 2 (Taiwan)	Mistral (France)
SA-12 (CIS)	FM-80 (China)	Anza-2 (Pakistan)	Solar (Brazil)
SA-14 (CIS)	KS-1 (China)	ZAHV-3 (S. Africa)	

### Gun-Missile Complexes



2S6 (CIS)	ZA-SPADS (S. Africa)
ZUR-23-25 (CIS)	Sinai-23 (Egypt)
Type 390 (China)	ZPU-Anza (Pakistan)
Skyguard (Int'l)	BOFI GMC (Brazil)
SIDAM-25 (Italy)	HVSD / ADAM (Israel)

### Attack Helicopters



Ka-32 Havoc (CIS)	MBB 105 (Germany)
Mi-28 Hokum (CIS)	PAH-2 Tiger (Franco-German)
Mi-24 Hind (CIS)	MBB BK-117A-3M (Germany)
AH-1 Cobra (US)	Agusta 129A (Italy)
OH-58D (A) (US)	Rooivalk (S. Africa)
MD 530MG (US)	AS 341 (France)
AH-64 Apache (US)	AS 365 (France)
Westland Lynx (UK)	

[illegible]

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14. Ibid., 171.

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16. Ibid., 36.

17. Brian E. Powers, "Soviet Ground Air Defense: Doctrine and Tactics," Air Defense Artillery (Summer 1985): 40.

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